July 7th, 2002

Comments on FCC Spectrum Policy as Requested in Public Notice DA 02-1311
For Spectrum Policy Task Force
Federal Communications Commission
445 12th Street, S.W. TW-A325
Washington, DC 20554

Credentials

As owner and operator of Old Colorado City Communications company – a small Telecommunications Company which has delivered wired data communications services for profit to the public since 1984, Internet services since 1989, and Wireless Internet Services since 1995, I have 18 years hands-on experience in the technical, economic, regulatory, real world of grass roots urban and rural public data communications.

Since 1995 I have also been the Principal Investigator for 5 separate 'Wireless Field Tests' pressed on me by the National Science Foundation and funded through my company to a total of approximately $2 million, with a future $2.5 million project pending. These operational tests have included deploying, evaluating, and reporting on a wide variety of FCC Part 15 digital radios for support of general public, and especially rural, Education (1995-1997), for linking 3d world (Mongolia) institutions to the Internet where PTT data communications services were non-existent in cities (1995), for modeling wireless communications for US Field Environmental and Biological Sciences (1,200 scientists in 24 field projects) support in the Rain Forests of Puerto Rico, in the wooded lake country of Northern Wisconsin, in Central Alaska, on the outer islands of Chesapeake Bay (1999-2002). I have also been called upon as an advisor to national and international wireless projects. Most recently I have been called up to lend my wireless expertise to the national security problem of early detection and warning of biological or chemical attack. In these projects I have bought, studied, deployed, interfaced, evaluated in sustained field use over 15 brands and models of Part 15 radios from serial line FH 902-928Mhz, and both pre and post DSS 802.11b 2.4Ghz radios, to Spread Spectrum and UNII band 5.2 to 5.8Ghz radios operating from 1 to 20mbps. As well as interfacing some of them to Internet Satellite services for use in very remote areas.

I have been, since 1980, and in particular after the 1996 Telecommunications Act which mandated 'ubiquitous' national broadband services for all Americans no matter where they lived or worked, a strong public advocate for the use of affordable, competitive, reliable digital wireless technologies, and especially wireless requiring no license for use, to reach that national objective whether or not the telephone companies would do so, which they so far have not.

Overall Policy View

After 60 years of FCC regulation of spectrum based on the inability of radio technologies to permit spectrum to be 'shared,' various modern digital signal processing technologies

has brought a major revolution in radio. Spread spectrum, ultra-wide-band, and various methods used under UNII rules have permitted the spectrum to be used simultaneously by multiple users, at ever higher, more reliable, and secure, data speeds. While there are some absolute theoretical technical limits to this, from a practical standpoint the recent advances in digital signal processing has made the do-it-yourself Wi-Fi phenomenon possible as well as the rapid rise in the number of manufacturers, foreign and domestic, who are producing radios with varying capabilities all across the Part 15 and UNII bands.

This has permitted large numbers of Americans to gain broadband access to the Internet at the lowest possible cost, and from locations not served by any telephone or cable service. Isn't this in furtherance of the goals of the 1996 Telecommunications Act? And since there is no requirement for government – the FCC – to award the right to communicate by one means or another so long as license exempt radios are permitted, it also meets the criteria of 'technology neutral.' Thus I argue that digital wireless holds greater potential for reaching the 100% of all Americans broadband Internet connectivity goal, in the fastest time possible than by any other means, while doing nothing to harm the rights of licensed wireless carriers, or wireline telcos, to pursue the same goal by competitive means.

This is still very large country – 3,539,297 square miles - with less than 290 million people occupying its land. Or an average of just over 10 persons per square mile. Even if every American were equipped with a PDA and 802.11b radio operating under current power rules, we are so far from saturating the spectrum and causing unacceptable levels of interference in any but the smallest urban physical areas with high population density it is laughable. And where the need for wireless broadband is the greatest – in rural and suburbs, the likelihood of interference is the least.

Current generation 802.11b radios only represent the leading edge of commercial digital radios which will have immensely greater capabilities of extracting data at ever higher rates from noise at ever lower levels of power. The very recent emergence of ultra-wide band radio technology proves the point. And such radios can, by software defined radio management techniques, deal with ever greater problems of interference, complexity, and interconnectibility.

The point is, the FCC should have far more faith in continued technological advances to deal with potential interference issues than it currently exhibits. It acts surprised at 802.11b's capabilities and popularity. While the public just uses the technology because its cheap and effective, even though it operates in the unlicensed – which means no guarantees – bands. And it endures the occasional problems the same way it endures blind spots and overcrowding on the super regulated cell phone networks. Ultra-wide band radio developments promise other benefits, and its novel technology also was a surprise to regulators. But the FCC and NTIA took almost 3 years just to promulgate its first rules, even while these technologies show far more promise in accelerating progress toward the overall, law-mandated goal, than fiddling with legacy systems or fearing for the future.

So the FCC's main spectrum management policies, at root, should be structured to be able, rapidly, to adjust to change, and opportunity, always as measured against the national goals already set in laws – rather than remain preoccupied with legacy systems and their perpetuation and protection. Get on with it, FCC, and stop trying to anticipate and micromanage every possible problem. Let technology solve the problems technology creates.

One overall recommendation for Spectrum Management Policy is for the FCC to start promulgating rules and certifying radios and other devices which only licenses devices for a finite number of years – perhaps 5 to 7 years – requiring the manufacturer to either upgrade their radios, or cease manufacturing those obsolete models. Compel continued technological improvement as the price for using public spectrum, rather than follow the current economic fad of putting a market price on spectrum even if the devices which use it remain less spectrum efficient indefinitely. And this should follow the guiding principal of moving toward the ultimate goal of requiring ALL certified radios and emission devices to be digital, while progressively phasing out ALL analog systems. For this is the only way the spectrum is going to be able to accommodate all the wireless traffic that will come in the future.

And all legacy system owners and spectrum licensees should be put on notice that their license for use will be reviewed in 5 years for consideration of continuing it – if no technological advances in their area of spectrum has been demonstrated – or being continued only if later, less interfering radios are procured and installed, over generous periods of time, but ultimately requiring change – or being terminated in X years because license holders either do not use, or do not aquire available upgraded systems.

While we know that the US is going through a transitional period where the fixed, narrow band, frequency allocations and device licenses based on traditional 'real estate, 'scarce-spectrum' mind set, are being challenged by wide band, digital, shared spectrum capabilities, the FCC should spend far more staff effort and resources looking into the future and encourage, by liberal field testing rules, waivers, engagement with academic, government (ARPA, NSF), and commercial high tech entrepreneurs – the discovery and development of advanced propagation and reception techniques that will permit more users to use spectrum.

Specific Recommendations

Part 15 spread spectrum radios, whose first rules for new radios and bands of unlicensed spectrum were released only in 1985 – after decades of concerns about national security - have already shown the tremendous potential of such radios for a very wide range of uses in the most cost-effective manner. I have personally demonstrated the value and seen the limitations of such radios – many of them caused by the FCCs own rules - in the 915Mhz, 2.4Ghz, and 5.8Ghz bands for:

WIRELESS FOR EDUCATION

General public education. Unlicensed radios have been spottily used to link at T-1 to 10mbps speeds or higher, the several satellite schools of the 84,000 public schools in 16,000 school districts (and 15,000 public libraries) across their towns and cities at NO incremental or recurring monthly commercial charge cost. Across the United States, only 2,000 school districts consist of only one physical building, in which the only challenge is to get Internet broadband between an upstream ISP and the one building – within which Ethernet wires can distribute the signal to all classrooms. The other 12,000 districts consist of more than one building. The land between such buildings is never owned by the district. Therefore there are only two ways to link such buildings broadband – either by contracting with monopoly granted local loop carriers, such as Qwest, Verizon, BellSouth or SBC, to extend T-1 lines with recurring monthly costs ad infinitum between all buildings or, use no-license, therefore NO recurring cost digital radios, owned by the school, to span those distances.

(1) Specific example: School District 20, Colorado Springs, with 25 school building across a 7 mile radius installed, in 1995, both licensed (but monthly free) microwave, and 2mbps 2.4ghz radios to link their buildings. That was done at a ONE time cost of $601,000 in 1995. Today it could be done for $250,000. US West's bid was for $1.5 million installation costs, $12,000 a month thereafter. Had that school district gone with US West, over 10 years it would have cost $2.9 million, versus the one time $601,000. A 5 to one cost ratio. BUT that installation was made, in 1995 by that district, out of its own funds.

The problem is, today, that the FCC made a really really stupid ruling when the $2.25 Billion a year E-rate program was started in 1998. It ruled that schools could NOT buy and own digital radios with e-rate funds, and thus save billions of Universal Service funds over time. Instead the schools were forced to lease Telco lines because of FCC rules that schools could only buy telco 'services' wherever there was no local wireless ISP who could bid for the recurring cost 'service.' And there are still so few wireless ISPs that the vast majority of ALL public schools and libraries have been forced to contract with recurring cost telcos. As a consequence, though there are requests for over $5 billion a year from schools, where only $2.25 billion is available, the fund gets exhausted by recurring annual costs – rather than one-time unlicensed radio purchased. Billions of dollars have been collected by telcos from rate payers and then recycled into their own coffers because of FCC rules against one-time purchase of wireless by e-rate funds.

While this issue is not apparently related to this 'Spectrum Management' policy question, everything is connected to everything else in this matter of broadband and Internet connectivity, wired and wireless. IF all US public schools were well into the uses of unlicensed wireless between buildings (WANS) , within buildings (wireless LANS), the next most logical step would have been started with enormous benefits to Education. Every public school in the US should be able to put up antennas on their buildings, connected to Access Points, loan, sell, or give ALL 52,000,000 K-12 students and their 3,000,000 teachers, unlicensed radios (PC card, USB, or free standing) to take home within the boundaries of the school district, which is not an unlimited distance and then

use the broadband wireless link to the school and its resources, and through it out to the Internet nights and weekends. Whether or not the student's parents have a commercial dial up or other Internet account for their children to use. (And few would have, from home, broadband accounts). This would accelerate the transition of our public educational system from the current edifice-centered to the distributed learning and teaching future faster than anything else. BUT there is no policy relationship between the FCC rules for unlicensed radios – power and frequency – and a prime public use. Education.

Our studies in 1995 to 1997 of Wireless for Education revealed that the mean distance across school districts is about 15 miles, or 7 miles radius. . Current rules radios simply cannot reach all homes of all students over these distances. When the UNII band Report and Order was announced the Chief of OET announced to the Commissioners and Press that the 'problem' of education had been solved by this new set of bands. But there was absolutely NO correspondence between the range limitations that the order compelled, and the actual radio ranges needed for education, even though the boundaries of districts are finite and measurable, thus knowable. To support such a sweeping, educational revolution radio power and frequency rules for unlicensed spectrum have to be designed to support reaching people where they live, work, and study, not make people adapt to where wireless links exist, based on a somewhat arbitrary FCC decision as to the degree of potential interference may arise.

Thus a major problem I find with the spectrum policy process for unlicensed radios is that, rather than start with the broadband-link requirement (the public interest), and make rules to support that requirement, it starts and remains centered on the radios themselves, making the public just adapt to those.

Whether or not it is by changes to the general rules for Unlicensed wireless, OR by application of the idea in the Public Notice paragraph 2b under Assignment Policies of 'defining power limits at geographic and frequency boundaries' the FCC should permit ALL US public schools to reach the boundaries of their school district with power and frequencies – unlicensed – that can penetrate the walls of all student's homes. Either by sufficient permitted EIRP power, or by making much lower (than 902-928Mhz) frequencies available for unlicensed radio. Since all school boundaries are physically and legally defined across the United States, it would not be hard to allow, and police, the allowed power.

Such a policy would immediately benefit 52,000,000 K-12 students, and 3,000,000 teachers – one sixth the US population.

(2) Specific example #2 – the San Luis School District.

In providing broadband to schools, and their students, either in buildings or at home, there is the separate cost issue of providing sufficient broadband service between the principal school building and the closest upstream ISP or data line provider. In rural areas, this cost, if the service is provided by traditional telcos, can be a huge burden. In the case of the San Luis, Colorado school, in a town of 800 (which is among the poorest

per capita counties in America), the road distance to the nearest upstream ISP is 40 miles. The direct, across the plains distance is 30 miles. The quoted US West (at the time) T-1 LOCAL LOOP charge between San Luis and Alamosa was $2,000 per month. I should have been able to use a nearby tower and reach Alamosa direct line of sight across the plains 30 miles, using unlicensed radios for $0 cost per month. (The Internet charges at the Alamosa pop was $500 a month, T-1.)

BUT, with only the 4 watt, (36dBm) EIRP allowable power, the 30 miles, given also some fresnel zone and vegetation problems, that distance could not be reached. Since we were engaged in an NSF Test project, we tested a 5 watt amplifier on the line with an 8 dB yagi, or 43 total Dbm across that barren, unpopulated, plain. THAT worked. And the difference being able to use practical level wireless, or costly teleco services, would have been $24,000 a year out of the poor school's budget, or the one time cost (about $2,000 and $500 amplifier) and $0 running costs. Its not even arguable that the Public Interest demands rules by the FCC that lets public institutions, such as schools, avail themselves of the full potential of unlicensed wireless in order to avoid the extreme costs levied by telephone companies for rural broadband, where costs are related to distance – and lack of competition.

Thus there is a strong public interest case for designing rules to permit unlicensed wireless support both rural and urban educational institutions at the lowest feasible cost.

FIELD SCIENCE

Another complete public sector that seems to be totally off the FCC's radar screen for spectrum management policy is the large, and growing amount of Field Science being done by trained scientists supported by universities, government agencies, such as the National Science Foundation and national and international, particularly environmental and biological, in which data must be collected from remote field locations. Unlicensed wireless devices hold great potential for permitting data gathering from these locations, however FCC rules for both permitted frequencies, and power, severely limit their use. This is true even though the vast majority of places where this science takes place, and data must be continually gathered is in remote, forested, geographically difficult terrain. Places where RF 'interference' with other human activity is very, very unlikely.

I should not have to detail for this Task Force the increasing dependence of this nation on the findings of environmental science as problems of global warming, air and water pollution, waste disposal, natural and manmade phenomenon grow. Many of these phenomenon are poorly understood. Which is why large sums of money and legions of scientists, their technical staffs, and graduate students are expended at gathering data from the field. At the present time over 1,200 scientists work in 25 field locations from the tropics to the Arctic circle in an NSF funded long term project called the Long Term Ecological Research (LTER) programs. Thousands more Researchers also work from 150 Biological Field Stations across the country. Additionally, with advanced networking capabilities linking the data bases of major universities and government agencies over the Internet at very high data rates permitting 'comparative visualization' systems, such

programs as the $100 million proposed NEON project (National Ecological Observatory Network) are on the drawing boards.

BUT, the NEON project needs, and expects, field data stations, and field data right down to small, individual sensors and data loggers, no matter where they are to be linked, real time to this network. Unlicensed, low cost, tree and forest penetrating digital wireless communications deployed at large scale is the only way this can be accomplished.

For 3 years I have carried out, for the National Science Foundation – both the Advanced Networking and Biological Sciences Division – a wide variety of tests of off the shelf Part 15 radios in the 915Mhz, 2.4Ghz, and 5.8Ghz bands operating under FCC rules to model the uses of wireless for such data gathering – and interconnection to the Internet - in a variety of places where such field science is being done. The Scientific community wants these capabilities. The demand is increasing rapidly.

But while I have been able, using all sorts of technical tricks, while expending unnecessary funds and building unnecessary structures to create radio relays to get the RF signal (power and frequency) permitted by the FCC through jungle trees, northern forests, across bodies of water across snow and ice fields, the severe limitation of such FCC approved radios operating according to the rules is patently obvious. Yet in every single case there is virtually NO potential for RF interference with other radios. And in areas where numbers of scientists are conducting separate experiments, it is trivial to personally coordinate the use of frequencies with the very few others in the area.

I am compelled to rely heavily on 902-928Mhz radios for their comparative vegetation penetrating qualities. Which is poor, but vastly better than any radios in the 2.4-2.483Ghz range – which are virtually useless for penetrating vegetation. And 5.8 UNII radios are useless where data loggers are in any kind of vegetated areas.

The penetrating capability of the best receiver-sensitivity 902-928Mhz radio from FreeWave, operating at 1 full watt of power at the radio, and with a 16dBm directional antenna cannot go more than ½ of a mile through northern Wisconsin woods, where extensive water studies are being conducted. It requires construction of 120 foot towers over the trees, or the use of balloons to fetch the data out to 2 miles – even at 9600 baud rates – from $3,000 data loggers. The radios should be able to reach 3 miles through woods or 5 miles from towers to be really cost effective. If they cannot be reached then integrating, or fetching, real time data over the Internet becomes impossible.

The situation is similar in the El Yunque National Experimental Forest, a rain forest, in Puerto Rico, where extensive studies are being made both by University based researchers and scientists of the US National Forest Service. Absorption of the signal strength by wet vegetation limits the range of standard radios in the jungle. A network of 6 radios is currently being used in that rain forest, to permit the fetching or weather data from 140 foot towers above the canopy.

Three years intense experience with such deployments in support of important US Science demonstrates a need for unlicensed spectrum much further down in the frequency table – such as a band centered on 450mhz – to permit radios to be built which can penetrate vegetation in areas where 'interference' with other radios is not even a consideration.

Another example. Years of science is being done in coastal areas of the United States, on off shore islands, including uninhabited ones. One such project under the University of Virginia which I have supported with NSF funds, involves a study area on Hog Island, 14 miles across the water from Oyster, Virginia, on the southern Chesapeake Bay peninsula. The problem is simple. It is both risky and time consuming to travel by boat to Hog Island, a narrow uninhabited island on the Atlantic Ocean. Scientists want to fetch wirelessly not only sensor data from data loggers placed on the island, but also place video cams to observe and record both wildlife and weather action while no human is on the island. They also would like to be able to monitor radar weather data real time while on the water when they must travel to the island.

Because of the limitation of permitted EIRP power and just a very thin screen of trees on the near land, it has been impossible to reach the island, even to a 70 foot tower, with 2.4ghz 10mbps radios. We had to use a pair of Canadian (Wi-Lan) 902-928Mhz radios which gave intermittent signal when within directional antenna gain rules. Only if the antenna goes above 36dBm can the island be reached. Interference potential? The yagi antenna is aimed out to sea, and there is no human habitation within miles of the field station on the near shore.

Another set of field science projects I am involved in takes place in both Central Alaska, and North of the Arctic Circle. In one case, three data loggers are 16 miles down the Tanana River from Fairbanks Alaska and its University. For years it has required 1 full time paid staff person, power boats and snowmobiles to travel down the river twice a week to fetch the data manually (memory modules) from these three data loggers, which have 9,600 baud RS232 ports. Only with the greatest difficulty, due to the power limitations of certified radios, have we been able to fetch that data wirelessly using a midpoint (8 mile) radio relay station. Once again it has less to do with the distance, which in clear line of sight is workable, but the ground level trees and vegetation both around the relay sites and in the last ¼ miles off the river in the trees, makes the link marginal. A wet snowfall, clinging to the trees, can defeat the link for days. Lower frequency radios, and/or greater permitted power can make that project in the Bonanza Experimental Forest area workable. The Scientists at the University of Alaska would dearly like to put out 10, 20, 50 data loggers up and down the river basin, without having to hire many more manual data collector staffers, if we could assure them they could be reached at affordable cost. We can't with current radios operating under FCC rules.

A second and third set of field science locations are 40 miles northeast of Fairbanks in the Poker Flats research area, and 80 miles east of Nome, Alaska, where radio range, even in clear air is the issue that limits the work. And potential 'interference' problems are a joke.

Finally, in Biological Science, I have been asked to connect up, in real time, and deliver over the Internet real time the bodily behavior and reactions of hibernating Arctic Squirrels north of the Arctic Circle in their burrows 1-2 meters underground, with 1 to 3 feet of snow on top. This can only be done with ground penetrating radios, whose data from 10 to 20 points can be aggregated above ground, and linked to a polar orbiting satellites.

All the above are examples of real world environmental and biological field science being done all over the world, which could benefit enormously from the use of unlicensed data radios that can span the range, penetrate structures, and reach into the most remote areas enough to link to sensors where scientists know they must be.

In ALL the cases cited above, RF interference problems are utterly non existent. Yet, as always stressed in FCC deliberations on spectrum and power for unlicensed, 'interference' is raised as an objection to changing the rules. The FCC must take into account not just 'rural' networking wirelessly, but truly 'remote area' networking. And make the rules accordingly.

There are several ways to handle this. One way is to adopt the FCC procedures which are sometimes used in the case of licensed radios. Such radios can be licensed for geographic 'areas' within which the licensed radios can be moved around and redeployed.

I think that users of unlicensed radios in rural and remote areas should be permitted to request, and have granted much higher EIRP levels for a specific geographical area. The petitioners can ask for, and justify, their RF power needs. And, if the area includes concentrations of people, such as towns, there could be a requirement for public notice of intent, to which anyone can respond – to the FCC approving office, before approval.

And I think that a liberal system of Waivers for specific rural situations should be permitted – and processed in a timely manner. When our staff inquired of the FCC staff what it would take to get a wavier for permitted EIRP to reach Hog Island over 14 miles of uninhabited water, we were told it would be very difficult, time consuming, and probably refused in the end anyway. We don't try any more.

RURAL RECOMMENDATIONS

Given all the above – for rural education, field science, and small town and remote farm and ranch or other facility location - I recommend, that at the very least, EIRP rules for rural areas permit 40dBm – or 10 watts.

This can be implemented by continuing the current maximum 1 watt at the radio, while the permitted gain – urban 36dBm or rural 40dBm is achieved by either antenna gain, or amplifier gain, or both. Almost all 2.4Ghz 802.11b radios are made, for reasons of cost, only with 100Mw (20dBm) at the radio. (A very few recent models are 200Mw - 23dBm) So even to achieve the current 36dBm level requires a 16dB gain antenna – almost always directional. And to reach 40dBm requires a 20dBm gain antenna. Thus in

most all foreseeable cases the difference between permitting an unlicensed radio to operate at the lower power in urban areas, and the higher in rural, is a matter of external – to the radio – antenna or amplifier gain. There does not need to be 10watt radios certified.

It should be understood (and some of us who have worked closely with the field do not think the FCC knows this, or understands its implications) that there may be over 7,000 Wireless ISPs, most of them small businesses providing broadband in Rural America. And most of them are using Part 15 and UNII radios – although they often also use hybrid systems. While large ILECs and fiber companies, and CLECs are failing and in trouble, this Wireless ISP (WISP) sector appears very healthy. And IS delivering broadband where others cannot or will not. Their opinions in response on unlicensed issues to this Task Force Public Notice either directly individually, as I am filing, or through their representative organizations, such as the Wireless Communication International Association (WCIA) should be given careful attention. THEY are carrying out the 'ubiquitous' provisions of the Telecommunications Act in parts of America where none of the big corporations are doing so. And they can do a great deal more. They may even represent the ONLY viable private enterprise solution to the broadband last mile problem. When you hold 'Workshops' as stated in your Work Plan, you absolutely should invite both a representative of WCIA, and at least one or more individual, small business, Wireless ISPs. (there is no substitute for facing real grass roots operatives, instead of just lawyers from large firms). You might even benefit from dedicating one workshop ONLY to Part 15 and Wireless ISP issues.

EQUIPMENT CERTIFICATION

One of the most frustrating FCC rules to deal with by those of us fully experienced in deploying a wide variety of radios, antennas, power supplies, cables, and other items essential to operation is the 'Complete System Certification' rules.

While we are fully aware that if one puts a certified radio together with a certified antenna that was not certified as a complete 'system' there can be some undesirable, or out of bounds RF behavior. Could be. Not always 'Will be.'

But to hold, for enforcement purposes, that UNLESS a radio, its connectors, its cable by type, and length, and an antenna – even within the calculated bounds of permitted power – are certified 'as a complete system' in advance by the FCC, and by paid application of a manufacturer,. or else the user of 'certified radios' put together with 'certified antennas' is operating illegally, is a degree of hairsplitting that threatens the use of unlicensed radios for the widest possible public benefits.

First of all, forcing all use of wireless systems to the 'complete certified system' rule is to ignore the extremely wide and varied situations in which such radios are used. I certainly have detailed above some of those uses totally unforeseen by the FCC. If the FCC has certified a radio, and separately certified an antenna, so long as I stay within the permitted EIRP I should NOT be told I am breaking FCC rules because the radio manufacturer has not been willing to pay the substantial cost of getting that precise

antenna certified with that precise model radio. And even if there is some case for having such a rule in dense urban areas, where radios may be very close to each other, it is a ridiculous requirement for rural and remote areas. Where the challenge is to get ANY combination of radios, antennas, and amplifiers – all within EIRP rules – to work.

If the FCC makes different rules for Rural versus Urban – which it absolutely should, then the 'complete system certification' rule should be dropped for rural.

Secondly, the effect of that rule has been to encourage Radio Manufacturers to sell, at greatly inflated prices when compared with the competition, a small choice of antennas which they have gotten certified with their radios by the FCC. They have NO incentive to do otherwise, in fact to further certify some of the highest quality, and variegated (sectorized, smart, special form factor) antennas is a DISincentive to them.

Thirdly, the above leads to the fact that this rule is simply unenforceable in the real unlicensed radio world. The rule is so widely ignored, that it takes the focus off the more serious matter of whether or not the user is within the permitted EIRP.

Fourthly if this rule is strongly enforced, I have no choice but to recommend to scientists across the nation NOT to buy and install wireless systems for their field science. For the antenna, cable, connector needs of their profession is NOT met by urban-designed-for certified systems by most radio manufacturers. The market is too small to justify endless antenna-radio system tests by the FCC. Every installation for field science is a unique challenge, requiring assembly of discrete parts, cables, sometimes signal splitters, and specific antennas, weather proofing, custom interfaces, and a whole host of solutions rarely encountered in urban radio deployments. I simply cannot buy what scientists need from the general marketplace as complete 'certified' systems, including specific cable lengths.

This issue raises its head also in the matter of Wi-Fi client radios – which are usually based on PC card designs with built in wireless LAN antennas. which can either be inserted in a laptop, or PCMIA to PCI chassis to operate. I know of NO such client 802.11b card radio which has a radio power more than 200mw – 100 (Cisco 350) or 32 (Orinoco) being far more the case. But the FCC rule permits 36dBm EIRP for such radios. The only way to get a low cost laptop, or PCI card, or USB port radio to reach its target Access Point – is to attach a short pigtail to the card – sometimes an MMX type connector – which then goes to a standard N connector, which in turn can be attached to an antenna with greater gain than the tiny wireless LAN blade antenna.

But to require the manufacturer of that card radio to come to the FCC and have that Pigtail 'certified' as part of the whole radio system and then market such 'system certified' pigtails and tell purchasers of the card radio that they can ONLY use pigtails certified by the original radio manufacturers, is absurd.

This whole matter of 'system certification' needs to be reviewed.

However, every manufacturer of radios and antennas should be FCC required, not only to affix a label indicating it is FCC certified, but ALSO its chief characteristics – dbm in the case of antennas, angle of field, horizontal or vertical, radio power at the antenna port in the case of radios, and frequency ranges. Insufficiently labeled antennas cause more wrong power calculations than any other one factor.

CONNECTOR DESIGN

Another HUGE aggravation is the requirement by the FCC that all radios have a proprietary type, rather than standard – such as an 'N' connection between the radio and antenna. That rule is ONLY there to make it harder, and more expensive, for installers, wireless ISPs, or end users, to attach external antennas and standard cables to the radio. That requirement, besides making it really more costly to deploy a radio, such as an Access Point, introduces more unique 'points of failure' between the radios and antennas. That rule should simply be dropped. Period. And permit the manufacturers to decide what connector is required. Whatever FCC engineer thought he could 'control' the behavior of purchasers of unlicensed radios by requiring costly adapters, is simply out to lunch. He ought to be sent into the field to install a few hundred radios, and get real world field experience. Its hard enough to set up wireless networks and get them working reliably not to have more technical barriers which have nothing to do with radio performance thrown at them by FCC bureaucrats.

ANSWER TO QUESTION 16

I totally reject the philosophy that all spectrum use should be governed by economics. For that assumes that ALL uses of spectrum is for wireless commercial 'services' which is untrue. I have detailed above a large number of non-profit (education, research) uses of spectrum. Public use of spectrum SHOULD be free, in the first place. The only reason it is not, is because technology has not, until recently been able to permit it to be shared without interference. So the idea of 'auctioning' spectrum, was born when it was indistinguishable from real estate. That also led to large abuses as large corporations bid on spectrum, denying its use to others, for many reasons other than to put it to 'highest and best use.' Now that spectrum can be shared, interference should be dealt with technologically, and not economically, with as little FCC 'regulation' as possible.

INTERNATIONAL ISSUES

While it would be theoretically desirable for spectrum rules to be adopted internationally political, and in particular, military security reasons makes that an unrealistic goal. Common rules would greatly benefit US radio manufacturers who could gain global market share – to the benefit of the US economy (export volume) if they could make dual-country-use radios. In some ways, with early 2.4ghz radios being made to E-1 European (2mbps) rather than US T-1, (1.54mbps) standards permitted such radios to be sold both in the US and Europe. And in other cases – as example Freewave DRG115 915mhz radios – 'software switches' can permit radios which can operate under US rules to be switched to be compliant with foreign rules, without making another model radio.

Freewaves we installed in Mongolia had to operate at 915-928Mhz rather than US 902-928Mhz under their rules. A simple menu driven software switch made that possible. Thus smart radio software can go a long ways to bridge international rule differences. The FCC should encourage such international adaptability of US radios.

I have been retained as a consultant by national organizations in Wales, with the strong endorsement and support of the Welsh National Assembly, to assist that country in connecting up 100% of its 3 million population, broadband, by use of both 802.11b and 5.8ghz unlicensed radios connected from the local community level, to upstream wired ISP links. British Telecom is in such economic and management disarray it has informed the British Parliament it will be unable to provide broadband to rural areas without huge government subsidies, before 2022. The Welsh are not waiting. After learning from and through me of the ability and cost effectiveness of unlicensed digital radios, they have embraced it fully, and retained me to deploy the first model wireless community.

The reason this can be done economically is that the UK spectrum rules permit 802.11b radios to be used, but only at 100mw – 20dBm – power levels, rather than 36dbm as in the US. And only within the last month has the UK Radiocomms Authority approved unlicensed for commercial use. The ITU seems to be following their lead. Fortunately 802.11b radios made by Cisco Corporation, can be set, in software, to deliver from 15 to a full 100mw at the radio, AND the PC card versions can be fitted with pigtail connectors and external directional antennas. Thus Cisco radios are being imported to Wales, and I am able to bring several with me this month to develop the 'model' in Ogwen Valley.

The point of this is that the US is several years ahead of most of the rest of the world in the design of digital radios, AND its FCC rules are being adapted to those new capabilities, including unlicensed (and perhaps the changes which will come out of this Task Force work) Question #25 implies that the US should accommodate international, like ITU, spectrum rules and policies. I do not agree. I think the US should permit the manufacture of the best possible radios that can serve the public, make rules to support those capabilities, and let the rest of the world follow the US lead. The US should lead, not follow, or dummy down to lowest common denominator ITU levels in its rules.

An announcement last week revealed that India is now permitting 802.11b radios, after they have observed its great success in the US.

The point cannot be over stressed, that over 100 nations of the 3d world will not, and cannot, afford to follow the US 'wired-telephone-company' lead in developing their own broadband for their nations. Instead they can, and seem to want to, overleap the entire wired telco history of the US, and go directly to broadband wireless. And I predict they will also resort to 'locally owned' (municipal, county, region, nation) gigabit fiber NOT owned and controlled by telephone companies. And use that for long distance delivery of the Internet, and let future gigabit wireless deliver the last 1, 10, 50 miles, unlicensed, to their populations. That is absolutely in the interest of the United States, for when our small wireless device industry starts shipping billions of US made radios we will

dominate the world markets for wireless the same way we dominated the Microcomputer markets using 'Made in America' small computers.

The FCC should do nothing to impede that promising future, and in fact encourage and take 'international' spectrum policies and opportunities into account when it makes manufacturer and spectrum domestic rules.

1996 TELECOMMUNICATIONS ACT

When I, and numerous other wireless visionaries tried to persuade the FCC, and even its then Chairman Reed Hundt, to permit the 84,000 public schools and libraries in the US to use their portion of the $2.25 Billion e-rate funds to buy and install no-recurring cost wireless broadband radios, BEFORE the FCC rules were promulgated as a Report and Order, we kept being hit in the face with claims that the FCC could not do that because of the Law setting up e-rate. However I was NEVER able to get an authoritative legal opinion out of the FCC staff proving that point. (Many of us suspected that the lobbying be Telcos, who hated the idea that schools might not buy their services from them, was the real reason this really stupid prohibition on buying and using radios (including long range licensed microware systems where Part 15 radios could not reach between cities or between schools and ISPs) that would have saved everyone billions.

But IF it was an impediment in law, either by FCC legal 'interpretation' of the law, or by explicit and unambiguous language in the law, I never understood why the FCC did not go BACK to Congress, and either ask for a clarification of the 'Intent' of Congress (to waste billions of dollars with recurring costs, or benefit only the local loop monopoly telephone companies?) or ask for remedial legislation.

If laws passed by Congress affecting the use of spectrum are stupid, not in the public interest, or only in the economic interest of selected business sectors, then I suggest the FCC go back to Congress to seek remedies.

But having given up, in this important $2.25 billion a year issue affecting 52 million students, of persuading the FCC to correct its error, I have instead gone directly to Congress myself – those Congressmen and Senators now drafting much legislation concerning spectrum (Senator Lieberman among them) to start action to correct this from their side.

Those of us who work with, and know the immense potential for digital unlicensed radios mistrust the FCC's handling in the past of large Telephone companies who lobby it incessantly, and who dislike such wireless, and see it as a threat to their monopolies where they exist and there is no other competition. At the same time those same Telephone companies have shown both an inability and reluctance to extend broadband to the entire US population, wherever they live or work. Wireless is the only corrective to that situation, which has been dragging on for years. So part of the Spectrum Management Task Force recommendations had better address head on this question of

balancing unlicensed spectrum use and rights, with monopoly wireline rights to do business.

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